

## **SIMULATION AND VISUALIZATION OF CLOUDS AND BATTLEFIELD OBSCURANTS**

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### **ABSTRACT**

The modeling and simulation of the real world, such as those used or planned for High Level Architecture (HLA) exercises, require quantitatively accurate representation of atmospheric processes such as natural clouds, battlefield obscurants, and dust clouds generated by conventional munitions or nuclear explosions. Applications include training of soldiers, visualization of the battlefield as 'seen' by the human eye and sophisticated electro-optical devices such as missile terminal guidance systems and battle-damage sensors.

Many cloud representations in computer-generated scenes have appearances which look real to human viewers because the images are designed to recreate the human perceptual experience. However, these models are not physically based and cannot be extrapolated from the visible waveband (human eye response) to other wavebands used by optical sensors (such as infrared seekers), nor are they calibrated (quantitatively accurate) for use in simulation of sensor system operability.

This presentation will introduce the technical aspects of our modeling of the radiometric characteristics and visualization of battlefield materials. Ours is a physics-based model which allows correct scaling of cloud appearance in wavelength (infrared and visible bands) and for arbitrary viewing geometry (geometric relationship of the sun, the cloud, and the observer). This model provides a consistent treatment of optical clutter and obscuration associated with dust clouds in the atmosphere. Consistency across the radiation spectrum and from all viewer perspectives is achieved through the use of physics-based, radiometrically valid models of reflectivity, emissivity, and transmissivity. This equitability offered by this approach is essential for the fair handicapping of entities engaged in HLA exercises.

This presentation will also describe our technical approach including: (a) the stochastically structured 3-dimensional models of material characteristics which enable cloud viewing from any direction and (b) the radiometric properties of clouds which are based on an approximate solution of the radiative transfer equation. We will conclude with a video demonstration.